Abstract of the Invention

An optical device includes a stack of at least two different intersubband (ISB) optical sub-devices in which the gain/loss profiles of the individual ISB sub-devices are mutually adapted, or engineered, so as to generate a predetermined overall function for the combination. We define this combination device as being *heterogeneous* since not all of the individual ISB sub-devices are identical to one another. Illustratively, the parameters of each individual ISB sub-device that might be subject to this engineering process include: the peak energy of the ISB optical transitions (emission or absorption) associated with each RT region, the position of each sub-device in the stack; the oscillator strengths of these ISB transitions; the energy bandwidth of each transition; and the total length of the RT and I/R regions of each ISB sub-device. In one embodiment, our approach may be used to engineer a gain profile that has peaks at a multiplicity of different wavelengths, thus realizing a multi-wavelength ISB optical source in which the applied electric field self-proportions itself so that each individual ISB sub-device experiences the appropriate field strength for its particular design. Alternatively, the gain profile may be engineered to be relatively flat over a predetermined wavelength range. In another embodiment, our approach may be used to generate a function that compensates for a characteristic of another device. For example, our heterogeneous ISB device may be engineered to have a gain profile that compensates for the loss profile of another device. Alternatively, the gain/loss profile may be engineered to produce a nonlinear refractive index profile in our device that compensates for that of another device (e.g., an optical fiber).